WHAT IS CLAIMED IS:

1. A wireless communication apparatus that is employed in a multiple-input-multiple-output wireless communication system, comprising:

a plurality of antenna units that transmit or receive a radio frequency signal; and

a weight controlling unit that gives a weight with respect to each of the antenna units,

at least one of the antenna units being formed by an adaptive array antenna unit that has a plurality of antenna elements, and directivity being changed by varying weights with respect to the antenna elements,

the weight controlling unit including:

an eigenvalue calculating unit that calculates eigenvalues of a matrix represented by the product of a current channel matrix representing the transmission characteristics of wireless transmission channels of the respective antenna units and a conjugate transposed matrix of the current channel matrix;

an inverse calculation unit that calculates such a channel matrix as to have all eigenvalues within a predetermined range that includes the average value of the calculated eigenvalues but does not include the smallest one of the calculated eigenvalues; and

a directivity adjusting unit that adjusts the directivity of the adaptive array antenna unit, so that the current channel matrix approaches the channel matrix calculated by the inverse calculation unit.

2. The wireless communication apparatus as claimed in claim 1, further comprising a plurality of converter units that are provided for the plurality of antenna units, each converting a digital signal into an analog signal and vise versa,

wherein the weight controlling unit adds a weight to each signal to be input to or output from the converter units.

3. The wireless communication apparatus as claimed in claim 1, wherein each of the antenna units is formed by an adaptive array antenna unit.

4. The wireless communication apparatus as claimed in claim 1, wherein:

the adaptive array antenna unit includes a plurality of feeder antennas that are the antenna elements, and a compounding unit that compounds signals supplied from the feeder antennas; and

the directivity is adjusted by changing the relative amplitude or phase of each of the radio frequency signals with respect to the feeder antennas.

5. The wireless communication apparatus

as claimed in claim 1, wherein:

the antenna elements of the adaptive array antenna unit include a feeder antenna and a plurality of non-feeder antennas; and

the directivity is adjusted by changing a variable reactance value that is given to each of the non-feeder antennas.

6. The wireless communication apparatus as claimed in claim 1, wherein the antenna elements of the adaptive array antenna unit are polarized wave sharing antennas.

7. The wireless communication apparatus as claimed in claim 1, wherein the weight controlling unit adaptively controls the directivity so as to steer a main lobe toward a desired signal.

8. The wireless communication apparatus as claimed in claim 1, wherein the weight controlling unit adaptively controls the directivity so as to steer a null toward an interferer.

9. The wireless communication apparatus as claimed in claim 1, further comprising a channel

matrix calculating unit that measures one of the received radio frequency signals so as to calculate the current channel matrix.

10. The wireless communication apparatus as claimed in claim 9, wherein the channel matrix calculating unit utilizes code sequences that are allocated in advance to the antenna units, so as to distinguish matrix elements of the channel matrix from one another, the code sequences vertically crossing one another.

11. The wireless communication apparatus as claimed in claim 1, wherein the predetermined range does not include the largest value and the smallest value among the calculated eigenvalues.

12. The wireless communication apparatus as claimed in claim 1, wherein the inverse calculation unit calculates such a channel matrix that all eigenvalues become equal to the average value.

13. A multiple-input-multiple-output wireless communication system comprising a wireless transmission apparatus and a wireless reception apparatus,

at least one of the wireless transmission apparatus and the wireless reception apparatus

including:

a plurality of antenna units that transmit or receive a radio frequency signal; and

a weight controlling unit that gives a weight with respect to each of the antenna units,

at least one of the antenna units being formed by an adaptive array antenna unit that has a plurality of antenna elements, various weights being given to the antenna elements so as to change directivity, and

the weight controlling unit including:

an eigenvalue calculating unit that calculates eigenvalues of a matrix represented by the product of a current channel matrix representing the transmission characteristics of wireless transmission channels of the respective antenna units and a conjugate transposed matrix of the current channel matrix;

an inverse calculation unit that calculates such a channel matrix as to have all eigenvalues within a predetermined range that includes the average value of the calculated eigenvalues but does not include the smallest one of the calculated eigenvalues; and

a directivity adjusting unit that adjusts the directivity of the adaptive array antenna unit, so that the current channel matrix approaches the channel matrix calculated by the inverse calculation unit.

14. The multiple-input-multiple-output wireless communication system as claimed in claim 13, wherein the current channel matrix is known both to

the wireless transmission apparatus and the wireless reception apparatus.

15. The multiple-input-multiple-output wireless communication system as claimed in claim 13, wherein the wireless transmission apparatus is notified of the current channel matrix determined in the wireless reception apparatus.